

Main Injector Rookie Book

Figures and Illustrations

The full-page illustrations listed below are either embedded in the text or added to the end of each chapter.

Chapter 1: Modes of Operation

- 1-1 Fundamental Geography (map)
- 1-2 Protons into Main Injector (map)
- 1-3 Typical Ramp Waveforms
- 1-4 Antiproton Production (map)
- 1-5 120 GeV Fixed Target (map)
- 1-6 1 TeV Fixed Target (map)
- 1-7 Collider Mode: Protons into Main Injector (map)
- 1-8 Collider Mode: Coalesced Protons into Tevatron (map)
- 1-9 Collider Mode: Antiprotons into Main Injector (map)
- 1-10 Collider Mode: Antiprotons Accelerated in Main Injector (map)
- 1-11 Collider Mode: Coalesced Antiprotons into Tevatron (map)
- 1-12 Collider Mode: 36 X 36 Store, Stacking (map)

Chapter 2: Magnets and the Lattice

- 2-1 Main Dipole Distribution (map)
- 2-2 Main Dipole (cross-section)
- 2-3 Main Dipole Coil Current (exploded view)
- 2-4 Main Dipole Bus (ring-wide generalized schematic)
- 2-5 Hysteresis in a Main Injector Dipole Magnet
- 2-6 Main Quadrupole Bus (typical cross-section)
- 2-7 Quadrupole Bus (ring-wide generalized schematic)
- 2-8 Generalized Straight Sections (magnet types, to scale)
 - (a) Short
 - (b) Medium
 - (c) Long

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- 2-9 Main Injector Lattice Functions
- 2-10 Horizontal Corrector Dipole (cross-section)
- 2-11 Vertical Corrector Dipole (cross-section)
- 2-12 Skew Quad (cross-section)*
- 2-13 Trim Quad (cross-section)*
- 2-14 Sextupole (cross-section)
- 2-15 Octupole (cross-section)*
- 2-16 PDD (Permanent Double Dipole, cross-section)
- 2-17 PQP (Permanent Quadrupole, cross-section)
- 2-18 PGD Permanent Gradient Dipole Magnet (cross-section)
- 2-19 The 214 Girder: Typical Magnet Locations and Naming Conventions

The following maps (2-20 through 2-25) show the ring-wide distribution of the magnets, along with the associated CAMAC ramp cards and power supply connections:

- 2-20 Skew Quad (SQ) Distribution
- 2-21 Trim Quad Distribution
- 2-22 Focusing Sextupole (SF) Distribution
- 2-23 Defocusing Sextupole (SD) Distribution
- 2-24 Focusing Octupole (OF) Distribution
- 2-25 Defocusing Octupole (OD) Distribution

Chapter 3: Power Supplies

- 3-1 Kautz Rd. Substation (feeder schematic)
- 3-2 Pulsed Power to MI-20
- 3-3 Voltage Rectification Using SCRs
- 3-4 Hipot Loop, Main Dipole Bus (generalized schematic)
- 3-5(a) Hipot Loop, Ground Fault on Bus (generalized schematic)
- 3-5(b) To be announced
- 3-6 Corrector Power Supplies (typical rack layout, at MI-30)

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- 3-7 Power and Control for Correction Magnets (block diagram)
- 3-8 Corrector Power Supply and Switching Regulator (generalized schematic)

Chapter 4: Water in the Main Injector

- 4-1 Hydraulic Cell
- 4-2 Sister Cells
- 4-3 Main Injector LCW Flow (ring-wide map)
- 4-4 Service Building LCW (map)
- 4-5 Pond Water Circulation (ring-wide map)
- 4-6 Service Building LCW Controls (block schematic)
- 4-7 Tevatron/Main Injector LCW systems at CUB (map, generalized schematic)

Chapter 5: Vacuum

- 5-1 Main Injector Vacuum Sectors (ring-wide map with ion pumps and beam valves)
- 5-2 Ion Pump Permits (block diagram of typical sector controls)

Chapter 7: Beam Transport Lines

- 7-1 Generic Kicker
- 7-2 Lambertson Magnet
- 7-3 MI-8 Line
- 7-4 Vertical Profile of Upstream MI-8 Line
- 7-5 Reverse Bending Section, MI-8
- 7-6 Full Arc Cell (typical cell, MI-8 Line)
- 7-7 “Missing Dipole” Dispersion-Suppressor Cell (typical cell, MI-8 Line)
- 7-8 Horizontal Closure in Main Injector (beam trajectory)
- 7-9 Vertical Closure in Main Injector (beam trajectory)
- 7-10 Injection Kicker Timing and Control
- 7-11 MI-8 Line Power Supplies

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- 7-12 Power and Controls to a Typical MI-8 Dipole Corrector Magnet (block schematic)
- 7-13 MI-8 BPM and BLM Readbacks
- 7-14 MI-8 Multiwire
- 7-15 Vertical Profile of Abort Line
- 7-16 Abort Kicker Control
- 7-17 Abort Line Power Supplies
- 7-18 Beam Absorber Room (Top View)
- 7-19 Abort Diagnostics
- 7-20 Vertical Profile of the P1 Line
- 7-21 MI-52 Kicker Timing
- 7-22a 150 GeV Beam at LAMA
- 7-22b 150 GeV Beam at Q522
- 7-22c 8 GeV Beam LAMA, P1 Line
- 7-23 P1 Line Power Supplies
- 7-24 P1 Line Diagnostics
- 7-25 Vertical Profile of the P2 Line
- 7-26 P2 Line Power Supplies
- 7-27 P2 Line Diagnostics
- 7-28 Vertical Profile of the A1 Line
- 7-29 MI-62 Kicker Timing
- 7-30 P1 and A1 Corrector Dipole Supplies
- 7-31 A1 Line Diagnostics

Main Injector

Ancient History

The Main Injector accelerator replaced the venerable Main Ring, once the most powerful accelerator in the world. The Main Ring, originally designed in the 1960's as a 200 GeV machine, was housed in a four-mile circular tunnel. Two “upstream” machines, the Linac and Booster, accelerated protons to 8 GeV, which was the minimum energy acceptable to Main Ring. After acceleration to 200 GeV in the Main Ring, the beam was extracted, simultaneously, to several experiments external to the ring. Many successive improvements brought the energy of the Main Ring—and the experiments—to 500 GeV.